

Fig. 1

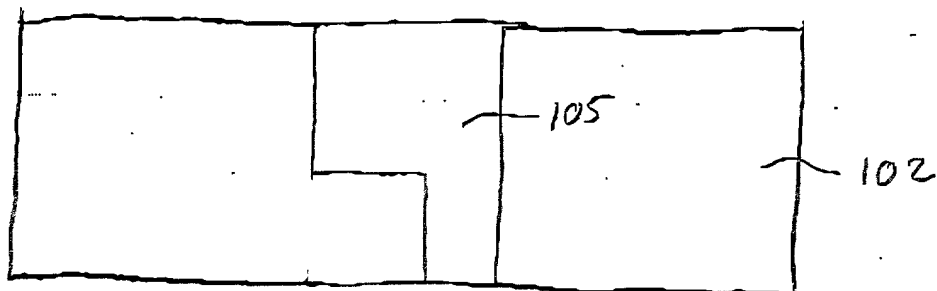


Fig. 2

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[illegible]

Form a copper layer overlying a patterned dielectric layer
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Form a doped layer superjacent the copper layer

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Thermally drive dopants from doped layer into copper layer

Fig. 3

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Form a copper layer overlying a patterned dielectric layer

Remove excess metal so as to form individual copper interconnect lines

Implant dopants into at least the interconnect lines
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Parameter	Value	Unit
Temperature	25.0	°C
Pressure	1.0	atm
Flow rate	1.0	L/min
Concentration	0.1	mol/L
pH	7.0	
Wavelength	254	nm
Scan rate	10	nm/min
Integration time	10	s
Resolution	0.5	nm
Slit width	1.0	nm
Detector	Photodiode array	
Software	Chromatography	
Hardware	PC	
Column	C18	
Mobile phase	Water/Acetonitrile	
Gradient	0-100	%
Flow rate	1.0	mL/min
Injection volume	10	μL
Sample concentration	0.1	mg/mL
Sample volume	10	μL
Sample matrix	Water	
Sample storage	4	°C
Sample stability	24	h
Sample recovery	100	%
Sample purity	100	%
Sample identification	Mass spectrometry	
Sample fragmentation	MS/MS	
Sample ionization	ESI	
Sample ionization voltage	3.0	kV
Sample ionization current	10	nA
Sample ionization temperature	100	°C
Sample ionization pressure	1.0	atm
Sample ionization flow rate	1.0	L/min
Sample ionization concentration	0.1	mol/L
Sample ionization pH	7.0	
Sample ionization wavelength	254	nm
Sample ionization scan rate	10	nm/min
Sample ionization integration time	10	s
Sample ionization resolution	0.5	nm
Sample ionization slit width	1.0	nm
Sample ionization detector	Photodiode array	
Sample ionization software	Chromatography	
Sample ionization hardware	PC	
Sample ionization column	C18	
Sample ionization mobile phase	Water/Acetonitrile	
Sample ionization gradient	0-100	%
Sample ionization flow rate	1.0	mL/min
Sample ionization injection volume	10	μL
Sample ionization sample concentration	0.1	mg/mL
Sample ionization sample volume	10	μL
Sample ionization sample matrix	Water	
Sample ionization sample storage	4	°C
Sample ionization sample stability	24	h
Sample ionization sample recovery	100	%
Sample ionization sample purity	100	%
Sample ionization sample identification	Mass spectrometry	
Sample ionization sample fragmentation	MS/MS	
Sample ionization sample ionization	ESI	
Sample ionization sample ionization voltage	3.0	kV
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Sample ionization sample ionization temperature	100	°C
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Sample ionization sample ionization hardware	PC	
Sample ionization sample ionization column	C18	
Sample ionization sample ionization mobile phase	Water/Acetonitrile	
Sample ionization sample ionization gradient	0-100	%
Sample ionization sample ionization flow rate	1.0	mL/min
Sample ionization sample ionization injection volume	10	μL
Sample ionization sample ionization sample concentration	0.1	mg/mL
Sample ionization sample ionization sample volume	10	μL
Sample ionization sample ionization sample matrix	Water	
Sample ionization sample ionization sample storage	4	°C
Sample ionization sample ionization sample stability	24	h
Sample ionization sample ionization sample recovery	100	%
Sample ionization sample ionization sample purity	100	%
Sample ionization sample ionization sample identification	Mass spectrometry	
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Sample ionization sample ionization sample ionization	ESI	
Sample ionization sample ionization sample ionization voltage	3.0	kV
Sample ionization sample ionization sample ionization current	10	nA
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Sample ionization sample ionization sample ionization column	C18	
Sample ionization sample ionization sample ionization mobile phase	Water/Acetonitrile	
Sample ionization sample ionization sample ionization gradient	0-100	%
Sample ionization sample ionization sample ionization flow rate	1.0	mL/min
Sample ionization sample ionization sample ionization injection volume	10	μL
Sample ionization sample ionization sample ionization sample concentration	0.1	mg/mL
Sample ionization sample ionization sample ionization sample volume	10	μL
Sample ionization sample ionization sample ionization sample matrix	Water	
Sample ionization sample ionization sample ionization sample storage	4	°C
Sample ionization sample ionization sample ionization sample stability	24	h
Sample ionization sample ionization sample ionization sample recovery	100	%
Sample ionization sample ionization sample ionization sample purity	100	%
Sample ionization sample ionization sample ionization sample identification	Mass spectrometry	
Sample ionization sample ionization sample ionization sample fragmentation	MS/MS	
Sample ionization sample ionization sample ionization sample ionization		

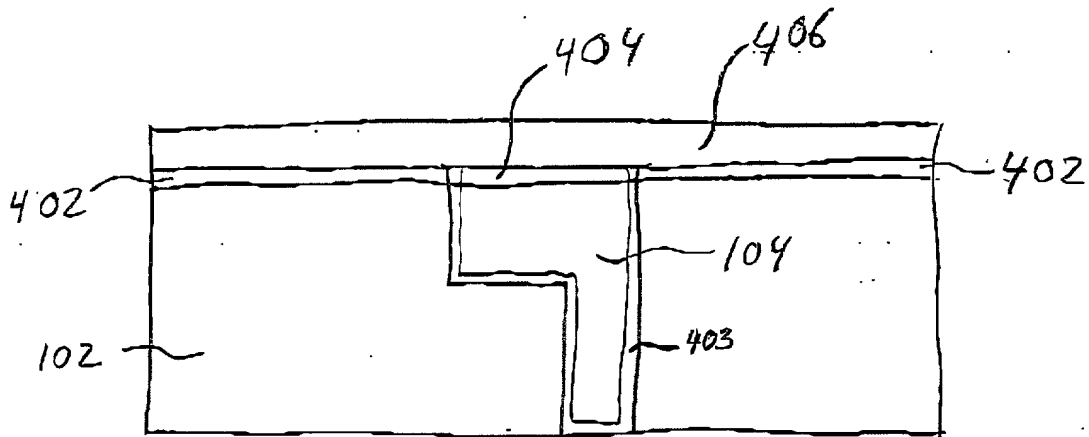


Fig. 4

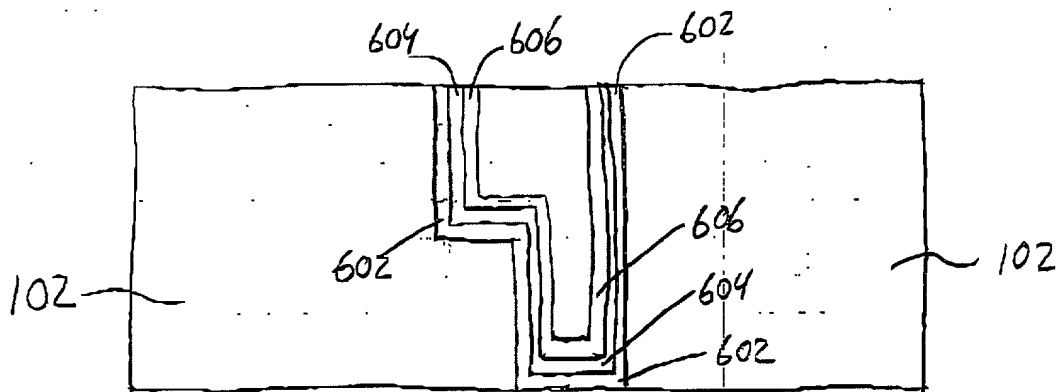


Fig. 6

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Pattern a dielectric layer to form at least trenches therein	702
Form a copper-diffusion barrier over the surfaces of the patterned dielectric layer	704
Deposit a doped seed layer over the barrier layer	706
Deposit a capping layer over the doped seed layer without exposing the doped seed layer to the atmosphere	708

[illegible]

Pattern a dielectric layer to form at least trenches therein
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Form a copper diffusion barrier over the surfaces of the patterned dielectric layer

Deposit a doped seed layer over the barrier layer

Deposit a capping layer over the doped seed layer without exposing the doped seed layer to the atmosphere

Deposit a copper layer over the capping layer

Thermally drive dopants from doped seed layer to upper portions of copper layer while providing atmosphere that reacts with dopant species

Parameter	Value	Unit
Initial concentration	1.0	g/L
Initial pH	7.0	
Temperature	25	°C
Time	0-24	h
Agitation speed	150	rpm
Batch size	100	L
Sampling interval	1	h
Number of replicates	3	
Statistical analysis	ANOVA	
Significance level	0.05	
Software	SPSS 20.0	